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# Evaluation of the effects of run off water on the Founkama plain in the Urban commune of Faranah, Republic of Guinea

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## Abstract

This research aims to assess the effects of runoff water on flood basins and structures.

To achieve this, we identified the decomposable and non-decomposable materials that ran off the flood basins and into the canals; the effects of runoff on the flood basins; Quantify the volumes of soil transported by runoff on the north and south sides of the said plain;

The research work took place from January 2 to October 31, 2014 inclusive.

The results obtained are as follows: The area occupied by non-decomposable materials in sample per m2 is: 106.74; the average weight of the samples is 4.6 kg; the height of earth transported in layers in the submersion basins in cm is: the North side 60, the South side 47.5 and in the central canal 58.6; the volume of earth transported in the canals in m3 is: in the North belt canal 224.4 in the South belt canal 89.25 and in the central canal 599.4; the influx of earth deposits by runoff water in the belt canals in cm is: South 58.188 and North 45.278.

**Keywords:** Evaluation; Effects; Water; Runoff; Plain; Founkama; Faranah; Guinea

## 1. Introduction

According to K. Y. KOUADIO, D. A. OCHOU and J. SERVAIN. (2007). In tropical regions, water erosion of soils is one of the major processes responsible for shaping the earth's surface and reducing the productivity of arable land.

According to NONI et Al. (1986). Rain is the most aggressive factor in the erosion of natural resources (soils); 50% of the country's territory is affected. This erosion leads to runoff, which is a widespread environmental phenomenon in the intertropical zone, due to the aggressiveness of rains, environmental degradation due in particular to overgrazing and excessive cutting of wood, which strip the soil.

According to NONI et Al. (1986), rain should be mentioned first because it is the most aggressive factor in erosion. Erosion is one of the most active factors in the degradation of natural resources (soils); 50% of the country's territory is affected.

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In the Faranah prefecture, the developed or undeveloped lowlands are affected by runoff water (silting, varietal mixing, temporary submersion, dissemination of weed seeds, etc.) from the watersheds.

The Founkama plain has soils rich in proportion to aggregates (sand, silt, clay and gravel); the profiles are homogeneous and very permeable but, under the action of rain, a layer of beating forms as soon as they are bare.

In fact, precipitation is particularly aggressive in this humid tropical transition zone where the average annual rainfall is around 2000mm. It is this rainfall that causes runoff and leads to water erosion.

According to BOLI BABOULE et Al. (1995). Erosion is a negative impact on crop yield through crop population density and fertility losses (nutrient, organic matter in clay).

According to BOUCHER. (2010), known as the Universal Land Loss Equation (EUPT), the Assessment of the effects of runoff water is an essential tool in an approach to combat water erosion which is a fundamental effect of runoff.

According to MISSANTE G. (1964), agriculture is an activity practiced in all regions of the world. When rainfall does not provide enough moisture to the soil, irrigation is carried out according to the type of crop and the nature of the agricultural area. In arid areas, irrigation can begin as soon as sowing under intensive production conditions.

In many agricultural regions, irrigation and / or watering is practiced during periods of drought to meet the water needs of crops. This system has significantly increased the usable areas and crop yields in the world.

It allows runoff water and therefore to locate the sectors requiring priority intervention.

In general, the plains and lowlands are exposed to the lack of control of irrigation, and in particular the Founkama plain.

It is invaded each year by water which causes the uprooting of newly transplanted plants (source of varietal mixture); silting; invasion by weeds and degradation of the structures.

The dam's reservoir has decreased following the input of sediment, the submersion basins located upstream of the plain are unexploited because of their invasion by runoff water.

## 2. Material and methods

### 2.1. Material

The Founkama estate which is our site is located on the right bank of the Niger River about 500m from the university campus of the Institute. It is limited to the East by the Faranah-Dabola National Road to the West by the Niger River to the North by the CRZ and to the South by the Faranah Koura district.

The total area of this plain is 150ha of which 80 are developed into rice fields. Its development system consists of a water retention dam with a capacity of $117529m^3$, a drainage channel of 1529m, two dilapidated belt channels (440m), distribution channels and a dam network separating the fields (submersion basin).

The soil is hydromorphic to temporary hydromorphic, of sandy-silty-clayey texture with a plant cover mainly composed of wild grasses and cyperaceae. The Founkama plain has submersion basins configured in three (3) main shapes (rectangular, triangular, and trapezoidal) with areas varying from 1200 to $2000m^2$ (South and North) or even $2500m^2$ in some places (North zone), with an irrigable perimeter of 150ha.

To open the profiles and determine the layers deposited by the runoff water in the profiles, the following materials were used:

- a decameter;
- a shovel;
- a pickaxe;
- a plastic bag;
- a Bic, a notebook and a PC for recording;
- tape, notebook, notepad, marker;

- The graduated iron bar to measure the depth of the layers.
- The prospecting was done on both sides of the Founkama plain (the first North-South submersion basins).

## 2.2. Method

The methodology consisted of:

- Consulting documents and resource persons;
- Visiting the field;
- Studying the state of the plain;
- Collecting, processing and analyzing data.

### *2.2.1. Field visit*

- Identifying submersion basins (lockers) and structures affected by runoff;
- Studying the effects of runoff water;
- Assessing the effects of runoff on structures and submersion basins (lockers);
- Identifying anthropogenic actions.

### *2.2.2. Site visit*

- Identifying runoff water entry points, the state of degradation;
- Measuring affected channels;
- Opening of profiles at the entry points of runoff water (belt channels, main channel and flood basin at the head);
- Sampling of deposited materials;
- In situ evaluation.

### *2.2.3. Evaluation of runoff effects during the study research period*

- Determination of the volume of soil brought into the flood basins, into the belt channels and into the central channel;
- Influx of deposit by runoff water from April to October 2014;
- Determination of the depth of the superimposed layers during the study period.

### *2.2.4. Sampling of non-decomposable materials*

The samples were taken in five (5) different locations, namely: in the submersion basins, in the irrigation (drainage) channels per $m^2$. The field activities focused on the collection and transport of samples in order to know the weight and surface area occupied by the components.

### *2.2.5. Opening of profiles*

The profile was opened in order to determine the height of the layers of soil previously deposited by the runoff water.

### *2.2.6. Determination of the volume of soil in the channels*

This evaluation method makes it possible to actually know the volume of soil deposited in the protection channels in order to proceed with their cleaning.

### *2.2.7. Deposit influx by runoff water*

From our field observation, the deposit influx was measured from the period from January to October 2014.

# 3. Results

## 3.1. At the end of our research work we have reached the following results:

The belt channels of the North and South parts were chosen to determine the influx of deposits by runoff water per month during the year 2014 (from January to October), depending on the rainfall. During the dry and rainy seasons the assessments were carried out on the channels and the submersion basins (lockers).

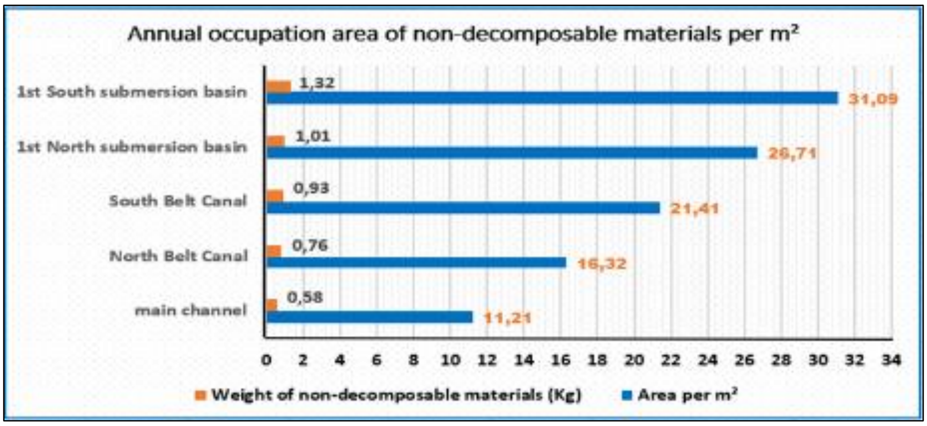


**Figure 1** Annual occupation area of non-decomposable materials per $m^2$

This figure shows that due to the effect of runoff water, the southern side of the plain receives more non-decomposable materials than the northern side. This considerably affects the submersion basins on this southern side.

**Table 1** Height of the different layers in the profile

| **N°** | **Nature of the layer** | **Rainfall intensity in mm/day** | **Height in cm** | | | ***Total*** |
|---|---|---|---|---|---|---|
| | | | South side | North side | Central | |
| **1** | Gravelly | 226,89 | 20 | 17,5 | 16 | *53,5* |
| **2** | Gravelly-sandy | | 25 | 19 | 25 | *69* |
| **3** | Sandblaster | | 15 | 11 | 17,6 | *43,6* |
| ***Total*** | | *226,89* | *60* | *47,5* | *58,6* | *166,1* |

The data in this table show that the southern side of the plain suffers from the effects of runoff waters than the northern side. Runoff waters from the northern and southern watersheds are loaded with silt, sand and gravel, carrying with them organic debris of all kinds which contribute greatly to the increase in the burial of runoff materials.

**Table 2** Determination of the volume of soil in the channels

| **N°** | **Channel Names** | **Linear length in (m)** | **Width at base in (m)** | **Width at crest in (m)** | **Thickness of soil in the channel in (m)** | **Surface in ($m^2$)** | **Volume of land in (m3)** |
|---|---|---|---|---|---|---|---|
| 1 | North Belt | 440 | 0,70 | 1 | 0,60 | 0,51 | 224,4 |
| 2 | South Belt | 250 | 0,70 | 1 | 0,42 | 0,357 | 89,25 |
| 3 | Central or drainage | 270 | 6 | 6 | 0,37 | 2,22 | 599,4 |
| Total | | 960 | 7,4 | 8 | 1,39 | 3,09 | 913,05 |

This table shows us that these channels are blocked by the effects of runoff water, and that they can no longer protect the submersion basins (lockers) in the event of a risk of rainfall.

**Table 3** Deposit influx in the North and South belt canal from January to October 2014

| Month of the year | Monthly rainfall amount (mm) | Number of rainy days in the month (j) | Deposit thickness (cm) | |
|---|---|---|---|---|
| | | | South side | North side |
| Janury | 2,5 | 1 | 0,082 | 0,063 |
| February | 0,0 | 0 | 0,00 | 0,00 |
| March | 15,8 | 1 | 0,520 | 0,404 |
| April | 72,9 | 6 | 2,399 | 1,864 |
| Mai | 276,7 | 19 | 9,107 | 7,076 |
| Jun | 223,0 | 16 | 7,339 | 5,703 |
| Jully | 175,0 | 16 | 5,759 | 4,475 |
| August | 346,6 | 19 | 11,407 | 8,864 |
| September | 516,3 | 20 | 17,0 | 13,21 |
| October | 141,5 | 13 | 4,657 | 3,619 |
| *Total* | *1770,3* | *111* | *58,188* | *45,278* |

It is clear from this table that runoff influences the southern side of the plain much more than the northern side. This is explained by the concentration of human activities on the watershed that feeds this side.

## 4. Discussions

At the end of our research we arrived at the following results:

- The annual rainfall height is 1770.3 mm. According to VLAAR (1992), rain is undoubtedly the main factor of runoff, which will then depend on the duration and intensity of precipitation.
- On the influx of runoff water indicated by SETRA, LCPC (2001) 32 cm is lower than that which we found (45.278 cm) on gravelly soil taking into account the amount of rain fallen. On the sandy gravelly one is 57.96 cm compared to 58.188 cm.
- About the annual occupation areas of non-decomposable materials (plastics, fabrics) per m2: our results of 26.71 $m^2$ (sandy-clayey) and 31.09 m2 (sand-gravel) are higher than those found by DUGUE P et Coll. (1994) in the same types of submersion basin.
- Concerning the heights of the different layers in the profiles, the results found in our study area are higher than those obtained by GIGOU, COULIBALY (1997): 53.5 cm (gravelly), 69 cm (gravelly-sandy), 43.6 cm (sandy) and 34.70 cm, 39.07 cm, and 21.02 cm.
- In addition to those found by SETRA, LCPC (2001), we found the quantities of soil transported by runoff water are, in the main canal 0.58 kg; North belt canal 0.76 kg; South belt canal 0.96 kg; first submersion basin on the North side 1.01 kg and first submersion basin on the South side 1.32 kg.
- Then we determined the volume of soil transported in the canals in m3: in the North belt canal 224.4; in the South belt canal 89.25 and in the central canal 599.4.

According to OUVRY, (1995), along the roads and on rural paths, the ditch allows runoff water to drain. Grassy ditches should be preferred in order to slow down the speed of water flow to the outlet.

## 5. Conclusion

In light of the results of our research work, the anthropogenic and edapho-climatic conditions are favorable to runoff on the one hand, and on the other hand to the deposition of non-decomposable materials (plastic, fabric, etc.) and organic materials, in the submersion basins (racks).

This present work has allowed us to obtain the negative effects of runoff water on the structures and the submersion basins (racks), namely:

- The annual occupation area of non-decomposable materials (plastics, fabrics, etc.) in the first submersion basins North and South is 106.74 $m^2$;
- The height of the different layers in the two profiles is: 166.1 cm;
- The linear influx of deposits by runoff water in the two profiles is estimated at: 103.466 m;
- The weight of the samples of non-decomposable materials is: 4.6kg and
- The sum of the volume of soil transported by runoff water in the different channels (central, South and North belt) is: 913.05$m^3$.
- In light of the results of this research work, it is found that runoff water has a great influence on the Founkama plain and promotes the mixing of rice varieties during each year.

This study can serve as a basis for research work aimed at strengthening knowledge in the context of evaluating the effects of runoff water on rice plains in the Republic of Guinea, for sustainable agriculture.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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